Job Loss Analysis

Control No: 2000152________ **Status:** Closed____________ **Original Date:** 01 July 2010

Last Date Closed: _______________

Organization: Gmfg

JLA Type: Global Mfg Shared____

Work Type: Technical Process Engineering____

Work Activity: Vacuum System Performance Check

Personal Protective Equipment (PPE)

☐ Goggles	☒ Hearing Protection	☐ Warning Device	☒ Gloves(Nitrile, rubber, leather)
☐ Face Shields	☒ Hard Hat	☐ Tagout/Lockout kit	☐ Other : Coveralls
☒ Safety Glasses	☒ Safety Shoes	☐ Hi Viz Jacket	☐ Other ________________
☐ Safety Back Belt	☐ Safety Cones	☐ Welding Hood	☐ Other ________________

Reviewers

Reviewer Name	Position	Date Approved
Michelle Johansen	Process Engineering Manager –RI/Global PED JLA team leader	11/13/10
Jacob Fritz	Lead Engineer --ES	11/10

Development Team

Development Team Member Name	Primary Contact	Position
Michael Delarosa	X 3265	Process Engineer
Tin Yin Lam	X 5715	Process Engineer (Vacuum System SME)
Scott Stratton	X 2995	Process Engineer (Crude Distillation SME)

Job Steps

No.	Job Steps	Potential Hazard	Critical Actions
1	Refresh your understanding of vacuum system operation & theory prior to conducting the performance check.	1.Understanding the fundamentals behind vacuum systems is essential for the purpose of collecting and interpreting data. A lack of understanding on vacuum systems may lead to an inconclusive or inaccurate interpretation of data.	1a.Consult BIN leader and/or "SME" for support and training. 1b.Useful reference documents include: • Chapter 10, How to Pull a Deep Vacuum - *Process Design for Reliable Operation 2nd Edition, Norman Lieberman.* • *Chapter 13,* Vacuum Towers- Ejector Problems – *Troubleshooting Process Operations 3rd Edition Norman Lieberman.* • Ejector System Troubleshooting – *Graham Manufacturing Co.* • See Steam Jet Vacuum Systems Troubleshooting Guide in table below*:*
2	Gather steam-ejector and vacuum condenser design documents.	1.Having the design information is necessary for comparing actual performance vs. design performance. Failing to acquire design information may lead to an inconclusive performance evaluation.	1.Acquire design documents and data sheets for vacuum system equipment. Critical documents are listed below: • Ejector test curves • Condenser data sheets • Ejector data sheets • PFD & P&ID's of vacuum system
3	Identify/list the process variables that we will need to have data for in order to perform a **complete** evaluation.	1.Failing to identify critical variables may lead to insufficient collection of data. This may require you to repeat the performance check so as to ensure that all important information is collected.	1.Create a list of all the important process variables specific to your vacuum system. In general, these variables are the following: • Process inspection history for steam nozzle condition. • Motive steam pressure and temperature. • Condenser CW rates • Condenser CW temps & pressures (inlet & outlet) • Inlet and outlet pressures & temperatures for all ejectors/ condensers • Measuring motive steam flow versus data sheet. • Off gas rate flow rate, • Off gas for air/ nitrogen content. • Dip leg level (check whether they are correctly sealed using an infra red gun).

4	Not all variables identified in step no. 3 will be continuously archived into the PI database for your convenience. Determine the availability of measurement tools or Chevron resources that can be utilized to perform a field survey for the missing information (temp, pressure, flow). For certain troubleshooting instances, pressure reading over a period of time is required. Data logging pressure gauges are needed.	1.Failing to acquire critical information may lead to insufficient data and an inconclusive evaluation. This can result from not having the proper measurement tools or field support during the survey. You may need to repeat the performance check so as to ensure that all important information is collected.	1a.Contact the technical, operations and maintenance groups for availability of measurement tools. These tools typically include the following: • Ultrasonic strap-on meter for measuring CW flow • Digital pressure gauge (manometer) for measuring vacuum pressures • Infrared gun for measuring CW temperature and level in the dip leg. • Analog pressure gauge for CW dP 1b.Consider contacting chevron support groups, such as Nalco, to help conduct surveys on the CW system.
5	Field walk vacuum system before-hand to verify that all points for measurement are physically accessible.	1.Performing a field survey without verifying that measurement points are accessible may result in an incomplete data set and inconclusive evaluation. May also result in significant loss of time & efficiency if the field survey is cancelled mid-way.	1a.Organize data onto a visual diagram of your vacuum system to aid during your analysis. 1b.Work with operations & maintenance to build staging as needed for inaccessible bleeders/piping. 1c.Plan to conduct field survey after verifying that measurement points are accessible.
6	Ensure proper tools on-hand for field survey	1.Loss of time and/or efficiency if required tools are not available while performing field survey.	1.Gather the necessary data during a single survey. Try to minimize the time elapsed in between readings. Include the following tools during field survey: • P&IDs of vacuum system for locating appropriate bleeders • Clock for time-stamping data • Extra batteries for any electrical equipment being used. Ensure all equipment is intrinsically safe. • Notebook and pens for organizing and recording data as they are acquired in the field.
7	Executing field survey	1.Not following good practices during field survey may result in inaccurate data and lead to an inconclusive or misleading analysis. Misleading data may lead to erroneous decisions on how to operate or repair system.	1.Good Practices: • Allow pressure to stabilize before recording any measurements • Note the “variance” of each pressure measurement in order to quantify process

			stability [(max value – min value)/2]. • Timestamp each data point
8	Analyze/Evaluate Data	1.The amount of system information can easily confuse you if not organized in a manner that's easy to understand. Not following good practices during data analysis may lead to erroneous decisions/conclusions.	1.List of good practices: • Referencing the composite ejector performance curves. • Create trends of information that is continuously logged into the PI database. Noticing step changes in performance may help you understand unusual system behavior. • Compare field data to design data and define what sections of vacuum system are under-performing, if any. • Calculate equivalent water vapor or air loading in order to determine if ejectors are operating on their test curves.
9	Consult vendor and/or ejector "SME" to assist with data analysis	1.Ejector system performance data is often difficult to interpret if you have minimal experience evaluating vacuum systems. Failing to get the appropriate resources involved may result in an inconclusive or false analysis.	1.Share data with SME to help interpret data. If expert has access to PI database, provide him/her with the necessary PI tags to help with trending data.
10	If vacuum looks to be underperforming, determine if additional investigation can help	1.Data can often point towards possible issues with vacuum system. Not following up with additional investigation may result in an inconclusive analysis.	1.Based on findings from data analysis, work with operations to organize additional field or process testing as needed. Investigation may include the following: • IR scans on equipment • Backflushing or acid cleaning exchangers • Adjusting vacuum loading (step testing column ovhd temperature and/or stripping steam rate)
11	Communicate and document findings for future reference	1.Potential loss of critical information on vacuum system health. Loss of this information may result in sub-optimal plant operation and economic downgrades of distillation products. 2.Future performance evaluations will require reference to previous ones in order to determine if vacuum is experiencing accelerated degradation. 3.Inefficient turnaround planning if	1.Upload analysis onto Global Documentation Warehouse. 2.Ensure copy of analysis/report is accessible in the appropriate shared directories. Be sure to note any assumptions or observations that may not be apparent to a future engineer. 3.Communicate findings to appropriate stakeholders and customers.

		information on vacuum health is not available.	

Steam Jet Vacuum System Troubleshooting Guide

Issue	Possible Cause	Possible Solutions
Completely/partially plugged steam nozzles	Foreign material in the steam supply, in particular from pipe fabrication at installation.	Disassemble, inspect and clean.
Wear of internal working surfaces of nozzles and diffusers.	Wet steam	Install a separator trap at ejector system. Insulate lines and trap low spots.
Insufficient energy supply.	Lower steam pressure than the minimum design pressure.	Raise the ejector steam pressure above the design minimum. A redesign may be required.
Suction flow overload and increased suction pressure.	Excessive air leaks and unexpected process loads.	Identify and resolve air leaks and process overloads.
Insufficient condensing and cooling. High condensing pressure.	Hotter cooling water temperature than design maximum. Lower cooler water flow than the design value.	Correct the supply temperature. Increase the water flow.
Too much friction in the ejectors and/ or too little heat transfer rate in condenser and/ or blockage of the condensate drain.	Fouling of internal working surfaces (process fluids or cooling water).	Clean parts.
Too much compression required given the design energy provided.	Higher system discharge pressure than the design maximum.	Decrease discharge pressure drop or redesign z stage.
Too much pressure drop between vacuum user and vacuum producer.	Suction pipe conditions: • Smaller size than connection. • Partially closed block valves. • Fouling. • Liquid traps. • Undersized in-line equipment.	Correct suction pipe condition.
Flooding of condensers.	Insufficient condensate removal provisions.	Clean tail pipe, check air for leaks. Assure operation of installed mechanical equipment.
Too much or too little steam flow	Excessive steam pressure and/ or temperature	Limit overpressure to approximately 125%. Limit superheat to approximately 50degF.